ROYAL ASTRONOMICAL SOCIETY.

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Dr. LEE in the Chair.

John Watson, Esq., Fence Houses, Durham;
Edward Tyler, Esq., Church Street, Stoke Newington;
Wm. Hislop, Esq., 108 St. John's Street Road;
Chandos Wren Hoskyns, Esq., Wroxhall Abbey, Warwickshire; and
Ch. Henry Weston, Esq., Sion Place, Bath,

were balloted for and duly elected Fellows of the Society.

The Lords Commissioners of the Admiralty have liberally placed at the disposal of the Society, for distribution among the Fellows, a limited number of copies of Hansen's Lunar Tables, which have recently been published in this country at the public expense. Any Fellow of the Society desirous of obtaining a copy of this important work should lose no time in applying for the same at the Apartments of the Society.

Abstract of Results of Measurements of Saturn's Satellites made at the Madras Observatory in 1856-7, *with the Lerebours Equatoreal. Ap.* 6·3 *in., foc.* 88·6 *in., power usually employed* 174. By Capt. W. S. Jacob, Director of the Madras Observatory.

"These observations extend over a period from 6th November to 24th March, and number as follows: of *Japetus*, 58 in angle and 41 in distance; of *Titan*, 67 and 53; of *Rhea*, 49 and 25; of *Dione*, 42 and 12; of *Tethys*, 49 and 15; from these the following elements were deduced by the method of least squares:

	Japetus.	Titan.	Rhea.	Dione.	Tethys.
	° ′	° ′	° ′	° ′	° ′
ϵ	78 9·0	299 42·8	288 43·5	115 30·5	281 42·8
$\delta\delta$	143 1·3	167 58·6	167 19·5	167 37·3	167 37·3
i	18 37·9	27 36·6	28 8·1	28 10·4	28 10·4
ϖ	349 20·0	257 6·9	185 0·0	145 4	109 7
e	0·28 443	·027937	·00080	·00310	·01086
a^n	514″·96	176″·90	76″·13	54″·85	42″·60
a^c	515 ·52	——	76 ·30	54 ·64	42 ·64
n	4°·538042	22°·577042	79°·690225	131°·534914	190°·697700

"Where ϵ is the epoch of mean longitude for Jan. 0·0 Green-

wich mean time; Ω, the place of the ascending node on the ecliptic; i, the inclination to the ecliptic; π, the place of the peri-planet; e, the excentricity; a^o, the semi-major axis at *Saturn's* mean distance, as derived from the distance measures; a^c, the same as deduced by Kepler's law from the value for *Titan; n*, the mean daily motion in longitude. The values of a^o and a^c agree as nearly as could be expected; even in the case of *Japetus*, the difference (0″·56) cannot be considered large, since, owing to the impossibility of obtaining measures at opposite elongations, this quantity includes the sum of the errors of distance and excentricity, as well as the effect of the different masses of the satellites; this latter will, doubtless, be quite sensible in the case of *Titan*, which is so much larger than the rest; indeed, if we subtract 0″·08 from the observed mean distance of *Titan*, the resulting mass of *Saturn* will then agree with the mean of those derived from the other satellites, and the error of *Japetus* will be reduced to 0″·32. This would indicate an excess in *Titan's* mass over the average mass of the other satellites, amounting to $\frac{1}{750}$ of that of *Saturn;* which is probably not much greater than the real quantity. The measures of the other satellites do not, therefore, suggest any sensible amount of correction to the observed mean distance of *Titan*, viz., 176″·90; and the corresponding value of the mass of *Saturn* + *Titan* is ·00028759 or $\frac{1}{3477\cdot3}$; the mass of the whole system will probably not differ much from $\frac{1}{3475}$ or $\frac{1}{3476}$.

"These observations do not indicate any sensible quantity for the mass of the ring; the effect of which would be to increase the apparent mass of the central body in the case of the inner satellites, or to give them a mean distance greater than that derived from Kepler's law. Now both *Rhea* and *Tethys* show a difference in the *opposite* direction; and though it is on the right side in *Dione's* case, yet little importance can be attached to this, as the observations of that satellite are fewer and of less weight than those of the others.

"Of *Enceladus* there are 27 observations, but as this satellite would rarely bear more than the very feeblest illumination of the field, the angles are mostly little better than mere estimates, and the errors in longitude range from -8° to $+6^\circ$; this, however, is less than half the range of Herschel's Cape Observations. No distance-measures could, of course, be attempted. All that can be deduced, therefore, is the epoch for Jan. 0, 1857, viz. 301° 55′; and the mean daily motion, 262°·73208; the latter agreeing very closely with Sir J. Herschel's determination. On 21st Jan. this satellite was seen and well measured when nearly in conjunction, opposite *Saturn's* south pole, the angle observed being 186° 8′ at 9^h 39^m Madras mean time; an event of somewhat rare occurrence, as noted by Mr. Lassell at p. 67, *Monthly Notices* for Jan. 1857.

"*Mimas* was observed 12 times, but bearing no illumination

whatever, the angles are even rougher estimates than those of *Enceladus*, the errors in longitude ranging from -23° to $+22^\circ$;* and as the previous observations of this satellite are very few, and most of them more or less doubtful, the exact periodic time is still uncertain. All the data accessible to me are, Sir W. Herschel's epoch for 1789·0 (as given by Vince); one doubtful observation by Sir J. Herschel at the Cape in 1836; and nine observations from 1846 to 1856, kindly communicated by W. Lassell, Esq. Of these last, some one or more *must* be erroneous, minute stars being probably observed by mistake: for by no conceivable rate of motion can they all be brought into agreement. If the daily motion be taken at 381°·9475, it will agree pretty well with Herschel's Cape Observation, and will include five of Lassell's; viz. those of 21st November, 1850, 28th and 30th December, 1852, and 1st and 8th January, 1853; and for the present I think this is the most probable quantity. The epoch for Jan. 0, 1857, will be $210^\circ\ 16' - 23{\cdot}6 \times \delta n$; δn being the difference of the *true* mean motion from that given above; the uncertainty of this epoch may be as much as 2° or 3°, independent of the error of mean motion. If it be desired to include a greater number of Lassell's observations, it will be needful to reject Herschel's; but the two observations of November and December 1856, given at p. 67 *Monthly Notice* for January, can by no means be reconciled with mine.

"On *Saturn's* next appearance we may hope to settle this point; and I trust that other astronomers, having powerful telescopes at their disposal, will give their aid; in any case where the satellite may be seen or suspected, it is desirable that it should be followed up for an hour or so, in order to be sure that the object seen is not a star.

"The observations of *Mimas* are given below; those of the other satellites will be published hereafter.

Madras Mean Time.				Pos. Ang.		Wt.	Madras Mean Time.				Pos. Ang.		Wt.
d	h	m	s	°	′		d	h	m	s	°	′	
Jan. 16	8	2	17	64	9	2	Jan. 23	7	51	37	261	57	2
20	10	14	21	275	17	2	24	7	57	16	258	5	2
21	8	3	16	281	35	2	25	12	30	0	100	51	1
—	9	18	34	269	41	3	—	13	6	52	94	0	1
—		45	18	264	44	2	Feb. 8	11	51	47	249	56	1
22	7	7	29	267	35	1	14	9	27	50	85	27	1

"The alterations in the mean motions of *Dione* and *Tethys*, indicated by Herschel, in his Cape Observations, are not confirmed; my excentricities also for *Rhea*, *Dione*, and *Tethys*, are much smaller than those which he assigns. My mean motion for

* If five doubtful observations be omitted, the errors will be reduced by nearly one-half; but I have thought it best to include them all, giving double weight to the undoubted ones; a portion of the error seems due to excentricity, or to some peculiar bias.

Japetus is derived from comparison with a few of Herschel's observations near conjunction, and may be in error as much as 1′ per annum; there is, therefore, still an uncertainty about the period of this satellite amounting to nearly 1^{m} of time.

"I may mention that the light-equation has been applied throughout to the times of observation, and that the observed distances have been corrected for refraction where needful; the correction in no case exceeding 1″·0, and being in general only a few hundredths.

"*Madras*, 10 *July*, 1857."

Results of the Observations of Small Planets made at the Royal Observatory, Greenwich, since July 1857.

(*Communicated by the Astronomer Royal.*)

Astrea.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1857, Sept. 16 13 55 17·0	1 39 5·55	86 26 35·85
28 13 0 31·5	1 31 29·67	87 40 31·83
Oct. 1 12 46 27·5	1 29 13·06	88 0 16·39
8 12 13 13·9	1 23 29·86	88 46 40·30
12 11 54 (10)	.....	89 11 32·67
13 11 49 16·6	1 19 11·42	89 18 58·61
19 11 20 28·9	1 13 58·28	89 55 45·24

Phocea.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1857, July 11 11 33 47·3	18 53 3·39	68 48 42·05
14 11 19 47·2	18 50 50·58	68 40 56·38
15 11 15 9·5	18 50 8·69	.....
18 11 1 17·1	18 48 3·66	68 39 1·50
28 10 16 25·9	18 42 30·75	69 13 35·39
29 10 12 5·6	18 42 6·28	69 19 49·28
31 10 3 29·9	18 41 22·23	69 33 46·85
Aug. 5 9 42 34·9	18 40 6·63	70 16 10·66

Victoria.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1856, Aug. 14 11 57 51·5	21 31 14·43	85 27 28·82
17 11 43 42·7	21 28 52·98	85 40 35·74
21 11 24 57·2	21 25 50·61	86 2 0·60
22 11 20 17·7	21 25 6·92	86 7 57·77
25 11 6 24·9	21 23 1·49	86 27 9·95
26 11 1 49·5	21 22 21·91	86 33 59·69
31 10 39 12·2	21 19 23·70	87 10 23·67
Sept. 1 10 34 45·2	21 18 52·49	87 18 4·75
4 10 21 34·0	21 17 28·82	87 41 36·84
5 10 17 13·7	21 17 4·34	87 50 40·48
14 9 39 35·0	21 14 48·38	89 2 52·51
23 9 4 38·6	21 15 15·25	90 12 40·02
26 8 53 37·0	21 16 1·55	90 34 5·86
28 8 46 25·8	21 16 42·24	90 47 42·04
29 8 42 53·2	21 17 5·62	90 54 17·49
Oct. 1 8 35 53·8	21 17 58·12	91 7 2·12
2 8 32 27·0	21 18 27·34	91 13 9·76
5 8 22 17·4	21 20 5·80	91 30 33·90
12 7 59 36·8	21 24 57·34	92 5 5·35
14 7 53 34·0	21 26 46·61	92 11 15·31
16 7 47 15·6	21 28 20·34	92 18 37·71
19 7 38 32·3	21 31 25·19	92 29 9·93

Irene.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1857, Oct. 16 13 59 5·1	3 41 10·87	79 29 59·90

Thetis.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1857, Sept. 16 12 36 14·3	0 19 49·82	96 1 53·93
28 11 38 41·7	0 9 26·41	97 24 52·72
29 11 33 54·7	0 8 35·25	97 31 6·93
Oct. 12 10 32 (30)	.....	98 36 11·84
16 10 14 19·1	23 55 47·91	98 50 14·95

Hygeia.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
h m s	h m s	° ′ ″
1857, Sept. 16 14 31 47·3	2 15 41·82	71 14 10·12
28 13 38 57·7	2 10 2·23	71 32 0·31
29 13 34 27·4	2 9 27·68	71 34 16·99
Oct. 1 13 25 23·7	2 8 15·61	71 39 3·18
8 12 53 16·6	2 3 39·12	71 59 7·25
16 12 16 0·0	1 57 48·84	72 27 50·78

On the Appearance of Round Bright Spots on one of the Belts of Jupiter. By the Rev. W. R. Dawes.

"I beg leave to bespeak the attention of observers to the round bright spots, which have again appeared on one of the belts in the southern hemisphere of the planet *Jupiter*. I noticed them for the first time in the spring of 1849; but, being otherwise much engaged, did not observe them closely. In March 1850 Mr. Lassell observed them in his 20-feet reflector, and sent a sketch of them to the Society. A copy of this in wood appeared in the *Monthly Notices* for April 1850. I am not aware that they have been distinctly seen since until the present apparition. On Sept. 16, I had a beautifully distinct view of them with the 8-inch object-glass at present in my observatory. The accompanying sketch of the southern hemisphere of the planet (Plate, Fig. 1) shows nearly their situation at about 11^h G. M. T. They were *five* in number; two being nearly equal in size, and almost as large as the *third* satellite appears when seen as a bright spot on the planet's disk pretty near the border. These were near together; and on the western side of them were three smaller ones scarcely so large as the *second* satellite appears on the disk of the planet. The middle one of the three was a little south of the line in which the other four were arranged.

"On Sept. 18 I again saw them well. At $13^h \pm$ G. M. T. they were a little further advanced on the disk than on the 16th at 11^h; but otherwise their appearance was much the same. I saw none on the *eastern* side of the two larger spots.

"Under the date, Sept. 16, I have entered in my observatory note-book, 'They (the two larger) seem to be very round, though I think, *not quite* without irregularities.'

"It is remarkable that their appearance now is on almost precisely the same part of *Jupiter's* disk as formerly: and I have

never been able to find any similar spots on any other part of the disk.

"On the 28th of this month (October) I had an excellent view of them; the state of the air being at times very favourable. In addition to the *five* seen in September, there were about as many more; and the old five appeared to me to be further apart than formerly. The whole group was arranged as in the accompanying sketch (Plate, Fig. 2); the original of which was made at the time, and refers to $9^h\ 15^m$ G. M. T.

"One more, however, has been introduced into this sketch, which was seen on the 30th. It is the second from the western, or left-hand side of the disk. When these had all passed off by the rotation of the planet, no others were visible, and there was indeed scarcely any appearance of a belt in that latitude. A very curious range of festoon-shaped shadings hung, as it were, from the under (northern) edge of the narrow dark belt which is situated a little north of the planet's equator. Four of them were very distinct, with a trace of another near each edge of the disk. The shading was uniformly darker on the western side in each of them. They reminded me of a very curious appearance which I sketched on March 8, 1851, when the lower or northern edge of the great southern equatoreal belt was deeply indented across the whole disk by five large and nearly regular arches. Except for a few nights after that date I do not recollect ever to have seen a similar appearance on the planet.

"Last night (Oct. 30) the spots were observed as they approached the planet's axial line. The air was in a less favourable state than on the 28th; yet occasionally the features of the planet were very distinct.

"The same spot which on the 28th seemed to be in the axis of *Jupiter* at $9^h\ 15^m$ G.M.T., was judged to be in the same situation at $10^h\ 54^m$. A sketch was made of the situations of the spots at that time.

"On comparing together the appearances on these two evenings, there is some evidence of change in the relative places of the spots. The small one which stands below a pretty large one (the *fourth* from the western side) has certainly removed further to the east than it was on the 28th. It was then decidedly to the *west* of the upper one; it is now a trifle to the *east*. Also the *seventh* from the west side is far less distinct in comparison with the rest than it was on the 28th. It was to be perceived at all only in the most tranquil moments.

"In judging accurately of the relative situation of the spots, it should not be overlooked that it is necessary to view them at very nearly the same point of the planet's rotation; as otherwise the effect is much varied by the change in the perspective.

"The festoons under the narrow northern equatoreal belt were again seen on the 30th, but less distinctly; probably from the less favourable state of the air.

"*Haddenham, Thame*, 1857, *Oct.* 31."

Postscript.

"I have procured the following additional observations of this curious phenomenon.

"1857, Nov. 17, $9^h\ 24^m \pm$ G.M.T. The belt in the southern hemisphere of *Jupiter*, on which alone the bright spots have hitherto appeared, is scarcely visible on the side now presented to us; only a few narrow faint streaks appearing in its place. But on the great southern equatoreal belt I now see, *for the first time*, several bright spots, two or three of which are of considerable size. The accompanying sketch shows their situations, and the general aspect of the planet at this time. (Plate, Fig. 3.)

"Nov. 18, $8^h\ 35^m \pm$ G.M.T. The southern equatoreal belt is separated from the belt to the south of it by a broad light streak on the western side of the planet, but they unite near the axial line, and on the eastern side they form one very broad and pretty uniform belt. There are two or three round bright spots on the equatoreal belt, as sketched: but the air is in a very disturbed state, and I can scarcely get a firm view of those on the belt south of it. Two only come out with anything like distinctness. The spots on the equatoreal belt do not appear to be quite round when best seen; and to the east of them are two others, which look as if they were *imperfectly formed*, being more distinct on their left-hand edge than on their right. See sketch of the appearances at this time. (Plate, Fig. 4.)

"At the time of observation on Nov. 17, the planet had advanced in its rotation about 130° further than at the time on Oct. 28, to which the sketch for that day refers; and at $8^h\ 35^m$ on the 18th, about 248° further.

"*Haddenham, Thame*, 1857, *Nov.* 21."

Notes on the Nebula of Orion and other Astronomical Subjects.

By Prof. Secchi.

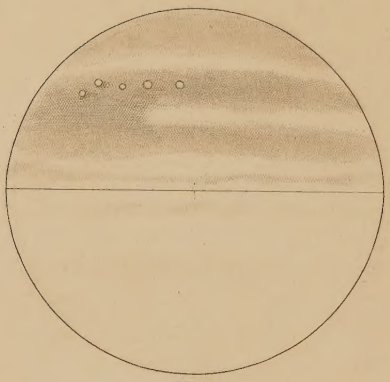
(*Letter to Mr. Carrington.*)

"The last letter of M. O. Struve, published in the *Monthly Notices*, Vol. xviii. page 225, about the nebula of *Orion*, and the recently-published discovery of M. Porro, induced me to examine the observations which I have made of this interesting object; and I beg leave to submit the results to the Society.*

"Some account of my observations has been already published in the *Memorie del Osservatorio*, page 92 (years 1852-56), and will be found to offer an interesting parallel with the observations of M. O. Struve. This last astronomer states (page 229) that the

* In regard to the two stars, the one of M. Porro and the other of De Vico, see the *Comptes Rendus* of the French Academy, 15 June, 1857.

1

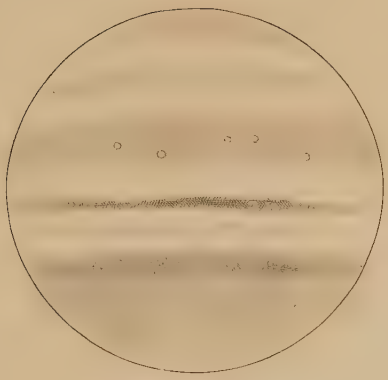


1857 Sept. 16.
at 11^{h}. G.M.T.

2

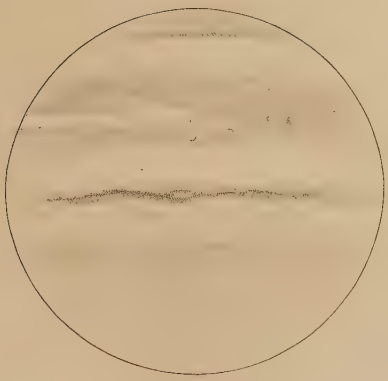
1857 Oct. 28.
at $9^{h}.15^{m}$. G.M.T.
and Oct. 30, at $10^{h}.54^{m}$.

3



1857 Nov. 17.
at 9h. 24m. G.M.T.

4



1857 Nov. 18.
at 8h. 35m. G.M.T.

J. Basire sc.

nebulous bridge which crosses the *Sinus Magnus* has been seen by him, '*always extending considerably further than, and nearly, if not entirely, approaching the southern boundary of the Sinus Magnus.*' This agrees with what has been described by myself, that is, that 'where Herschel places a kind of peninsula or promontory, and Bond only a little head, according to my view there was a bridge (*Lingua di nebbia*) crossing that kind of gulf.' M. Struve states that he has seen there a strong intensity of light, but I noticed that there was really a star; and this was seen also on other occasions.* The position of this star has been given; Sir J. Herschel's figures and his co-ordinates are $+ 4^{s}\cdot6$, $- 180$; I may also add that above this bridge the Sinus is a good deal more luminous than below it towards the mouth of the Sinus itself.

"In very fine nights I have persuaded myself that the trapezium is not on a *black* ground; but there is certainly a nebula, although not so bright as that which composes the patches around it. In last winter I tried to make a drawing of the nebula, but the weather was so unfavourable that I could not finish it. The central part, however, has been carried a good deal forward; and in the sketch taken on the 15th March, 1857, I find marked above the trapezium a small star, only determined by eye in position, which, related to the figure given by Sir John Herschel, has the co-ordinates $- 0^{s}\cdot50$ and $+ 100$. If this is not Struve's star, it must be very near it. Near the line joining α with ε of Herschel's figure I have marked three stars, only two of which are marked in H: besides, the stars ε and ζ are surrounded by nebulosity in my drawing. Certainly they are quite out of the general nebula, but are seen surrounded by a small particular aureola, as if enveloped in a particular bright nebula. As α trapezii is quite free from this appearance, I think this is not the effect of the atmosphere.

"In regard to the general appearance of the nebula, I find the drawing of Sir John Herschel at the Cape that which best agrees with my observations; but this, perhaps, does not imply that other drawings are incorrect, but only that the power of the instruments being very nearly the same, they give the same appearance. From repeated researches, indeed, I am persuaded that there is no great difference of penetrating power between a 9-inch Munich refractor and the telescope of Sir John Herschel. Hence, perhaps, the difference between this drawing and that of Mr. Lassell at Malta and others, may depend on the power of the instruments. As to small differences observable from evening to evening, it is very difficult to state if they are real or not. To have some guide in this as well as in the judgment of the magnitude of the small stars, I think it would be necessary to fix a common state of the atmosphere as a standard to be referred to. In a memoir 'On the Scintillation of Stars' inserted in the *Bibl. Universelle* of Geneva, I have given six figures of double stars as seen in different states of air; and a

* Professor Rispighi of Bologna was then present at this examination, and agreed with me.

reference to these is made every evening in the specification of the state of the atmosphere during the observations of double stars. A similar examination of double stars should be made before examining a difficult object, and it would be desirable to determine every evening what kind of images are given by means of some chosen test-objects. Without attending to this circumstance, the state of the atmosphere may lead to many faulty estimations. Here, in Rome, some small stars disappear on very fine evenings for want of steadiness or good definition: some nebulæ, which appear resolvable, are not, and *vice versâ*. I think, therefore, that a conventional indication of the state of the atmosphere ought to be introduced among the data to be registered in very delicate observations. In illustration of this remark, I may state that in those evenings in which I could separate stars of half a second distance, I never failed to see the brighter patches of the nebula of *Orion* glittering, like star-dust; and likewise, under the same circumstances, the annular nebula of *Lyra* presented a similar aspect, while in other evenings a flat confused appearance was commonly obtained.

"In these evenings I am occupied in examining the brilliant places of the Via Lactea in *Sagittarius*, and especially in making figures and measures of clusters. Some of these are exceedingly interesting, since they appear to be real systems of stars. Such is, for instance, the cluster 3721 of H. Catal. ($\alpha = 17^h\ 52^m$, N. P. D. $= 117^\circ\ 53'$), which consists of a beautiful ruby star of the ninth magnitude, surrounded by a crown of others in a double ring, almost circular, of the most different colours and brilliancy. This object cannot fail to excite great interest. The effect, however, is increased, from the cluster at the following edge assuming the appearance of a perfectly black spot of the shape of a pear, about 4^m large. This spot, by its contrast, shows that the galaxy in that region is quite strewed with stars, which give a white aspect to the firmament. As a great many of these clusters are within the reach of moderate-sized instruments, it is desirable to have them measured and mapped.

"Since I have spoken of clusters, it will not be out of place to state a rather curious coincidence, which perhaps is not accidental in the creation. It is well known that the large stars occupy a zone in the heavens, which is determined by a great circle passing through the constellations, *Crucis*, *Orionis*, *Tauri*, and *Scorpii*. To find this circle is very easy; it is sufficient to place the star *Fomalhaut* in the zenith of a common celestial globe, and the horizon will mark the circle of the great stars. Now two things are very interesting about this circle: 1. The vertex of translation of the solar system, as determined by the calculations of Argelander, Struve, and Galloway, lies very near this circle. 2. The greatest number of globular stellar clusters lies in this circle also, or very near it. As several of these clusters contain thousands of stars, it is probable that if their light were concentrated into a single point, they would appear as a *large* star.

This idea leads to a conclusion very singular indeed,—that perhaps instead of a single star, a globular cluster has been formed, under circumstances and laws which will remain most probably always a mystery to mankind.

"I conclude with a special remark on the last appearance of Brorsen's comet. In the last days of observation, May 15, 17, 22, it had no nucleus at all, but only a very flat, large nebulous uniform appearance. Occasionally, however, it showed scattered points of light, as illuminated dust. I am sure that they were not stars seen through it, and that they had quite a different character from the scintillation of nebulæ. The observations will be published in the *Astronomische Nachrichten*.

"*Rome, July* 12, 1857."

Results of Measures of γ Virginis, taken at Mr. Worthington's Observatory, Crumpsall Hall, near Manchester, from 1857·29 *to* 1857·45. By Joseph Baxendell, Esq.

"The observations from which the following results have been derived were made with a parallel-wire micrometer constructed by Mr. Simms, attached to an excellent achromatic telescope of 5 inches aperture and 70 inches focal length, mounted equatoreally, and driven by clock-work. The telescope and mounting are the work of Mr. Dancer, of Manchester. The powers usually employed were 223 and 438. Weights were assigned to all the measures of position and distance, but they have not been used in deducing the following mean results; my experience of the system of assigning weights to the measures of double stars, and a careful examination of the results of its application by other observers, having led me to doubt whether any real advantage is gained by its use.

Mean Epoch.	Angle of Position.	Probable Error.	No. of Obs.
1857·40	172°·94	0°·10	64
	Distance.		
1857·41	3″·584	0″·018	60

"Reduced to the same epoch, the above angle of position agrees nearly with that obtained by the Astronomer Royal, as given in Admiral Smyth's communication at page 263 of the last number of the *Monthly Notices;* but differs fully 2° from the mean of the results obtained by Admiral Smyth, Lord Wrottesley, Mr. Dawes, and Mr. Fletcher. My observations were made with great care, and generally under favourable circumstances; and I may remark that the sets of measures, which were considered the most satisfactory, give a greater value for the angle of position than the mean of all the sets. The result for distance agrees very nearly with the mean of all the results given in Admiral Smyth's communication.

"*Manchester, Nov.* 12, 1857."

Observations of Victoria, taken at 2 South Parade, Oxford, with the Five-Feet Smythian Telescope, from the Hartwell House Observatory. By Norman Pogson, Esq.

(*Communicated by Dr. Lee.*)

Oxford M. T.		App. R.A.	Log. Par. × Δ	App. Decl.	Log. Par. × Δ	Comparisons.
1857.	h m s	° ′ ″		° ′ ″		
Aug. 1	12 52 56	325 17 37·7	−9·146	+4 55 9·2	+0·794	3 with *f*
	13 8 54	325 17 33·5	+9·646	+4 55 8·1	+0·794	4 — *f*
	13 53 32	325 17 11·4	+0ˢ·104	+4 55 8·7	+0·795	3 — *f*
2	10 37 33	325 8 6·6	−0·478	+4 55 30·6	+0·800	4 — *f*
	10 57 5	325 8 4·4	−0·420	+4 55 28·5	+0·799	2 — *g*
	11 9 17	325 7 51·9	−0·373	+4 55 30·1	+0·798	2 — *f*
9	13 1 11	323 47 36·2	+9·967	+4 47 53·0	+0·796	3 — *d*
	13 12 29	323 47 38·7	+0·071	+4 47 54·3	+0·796	8 — *e*
	13 27 26	323 47 23·9	+0·181	+4 47 51·0	+0·797	3 — *d*
14	14 21 7	322 47 23·7	+0·497	+4 32 1·3	+0·803	6 — *c*
30	13 8 28	319 58 45·8	+0·499	+2 56 17·5	+0·812	6 — *b*
Sept. 20	12 50 38	318 42 11·4	+0·633	+0 8 38·7	+0·826	5 — *a*
	13 6 39	318 42 11·6	+0·653	+0 8 33·5	+0·826	5 — *a*

The observations were taken with a ring-micrometer, and have been corrected for refraction, and proper motion of the planet during its passages across the ring. The times were noted by the aid of an excellent chronometer, kindly lent to me by Charles Frodsham, Esq., of 84 Strand. The following are the adopted positions of the comparison stars, half weight being allowed to places taken from Lalande's Catalogue:

Star.	Authority.	Mag.	Mean A.R. 1857·0.	Mean Decl. 1857·0.
			° ′ ″	° ′ ″
a	Weisse XXI. 303=41463 Lalande	8	318 26 2·0	+0 4 22·3
b	Weisse XXI. 476=41742 Lalande	8	320 12 17·7	+2 33 46·2
c	Weisse XXI. 776=42204 Lalande	9	323 10 0·6	+4 35 37·0
d	Weisse XXI. 815=42249 Lalande	8	323 27 51·9	+4 22 26·2
e	7 Pegasi=7547 B A C=Weisse XXI. 847=42295, 7 Lalande	6	323 46 36·3	+5 1 47·9
f	Weisse XXI. 1012=Piazzi XXI. 300=42551 Lalande	8	325 40 10·2	+4 32 53·5
g	Weisse XXI. 1030=42582 Lalande	9	325 54 29·6	+5 6 28·0

The variable star, U *Geminorum*, has lately appeared, and was estimated of the 9·7 magnitude on October 30th. Three days before it was *invisible*, with the Smythian telescope, and therefore less than the 12·3 magnitude in Argelander's scale. Cloudy weather has unfortunately prevented a strict determination of the time of maximum, and it has most probably vanished ere this for another three months. The period appears to be a day or two longer than 96 days; my first approximation, published in vol. xvii. page 200, S and T *Geminorum* are both past their maxima; the former, rapidly diminishing; the latter, quite gone. S *Ursæ Majoris* is, on the contrary, approaching its maximum, while R *Ursæ Majoris* is almost, and R *Cygni quite* invisible under the most favourable possible circumstances.

New Planet.

On the 19th of October a new planet, the 50th of the group between *Mars* and *Jupiter*, was discovered by Dr. Luther at the Bilk Observatory. The following approximate position was obtained by Dr. Luther on the evening of discovery.

	M.T. Bilk.	α	δ
1857, Oct. 19	7^h	$12^\circ\ 4'$	$+2^\circ\ 26'$
Daily motion	$\Delta\alpha = -8'$		$\Delta\delta = -6'$

The planet resembles a star of the tenth magnitude.

The following two positions were obtained, the one by Dr. Winnecke at the Bonn Observatory, on the 20th of October, and the other by M. Bruhns at the Berlin Observatory on the 21st of the same month.

	M.T. Bonn.	α	δ
1857, Oct. 20	$8^h\ 42^m\ 28^s$	$0^h\ 47^m\ 41^s{\cdot}47$	$+2^\circ\ 19'\ 44''{\cdot}2$
	M.T. Berlin.	α	δ
1857, Oct. 21	$8^h\ 55^m\ 52^s$	$11^\circ\ 47'\ 39''{\cdot}2$	$+2^\circ\ 14'\ 34''{\cdot}0$

This planet had been already discovered on the 4th of October by Mr. James Ferguson, of the National Observatory, Washington, as appears from the following letter addressed by Lieut. Maury, the director of the Observatory, to the Foreign Secretary of the Society:—

"*National Observatory,*
"*Washington, Oct.* 5, 1857.

"I have the pleasure to send you the place of a new planet, the 47th [50th].* It was discovered at 10 o'clock last night, by Mr. James Ferguson, with the large equatoreal of this Observatory.

* Lieut. Maury had not, of course, at the date of his letter, received intelligence of the discovery of planet (47) by Dr. Luther, on the 15th of September, and planets (48) and (49) by M. Goldschmidt, on the 19th of the same month.—R. G.

Observed Place of (47) [(50)], 11 Mag.

	M.T. Washington.	α	δ
	h m s	h m s	° ′ ″
Oct. 4	10 21 24·4	0 57 29·24	+3 58 37·31

"The daily motion is in right ascension 52 seconds retrograde, and in declination $-3'\ 54''$."

The planet has been named *Virginia* by the American discoverer, or by some individual to whom he may have delegated that honour. In No. 1118 of the *Astronomische Nachrichten*, we find a series of observations of the planet by Mr. Ferguson, extending from Oct. 4 to Oct. 21. The following are the positions for Oct. 20 and 21 :—

	M.T. Washington.	α	δ
	h m s	° ′ ″	° ′ ″
Oct. 20	7 41 41·8	0 47 35·39	2 18 41·54
21	7 39 59·5	0 47 4·26	2 13 32·30

A comparison of these observations with the positions of Luther's planet determined in Europe leaves no doubt respecting the identity of the two bodies.

Discovery of a new Comet. By Dr. Donati.

A new comet (Comet VI., 1857) was discovered by Dr. Donati at Florence on the 10th of November. Intelligence of the discovery was forthwith transmitted by the electric telegraph to the Paris Observatory, and thence, by the same means, to the Astronomer Royal, who lost no time in communicating the discovery to the Society. The following observations of the comet by its discoverer have since been received.

Observations of Comet VI., 1857. By Dr. Donati.

(*Communicated by S. M. Drach, Esq.*)

1857.	Florence M.T.	Comet — Star. R.A.	Decl.	No. of Comparisons.	Comet's App. R.A.	Comet's App. Decl.
	h m s	m s	′ ″		h m s	° ′ ″
Nov. 10	7 5 34	+3 20·54	+3 9·7	1 *a*	15 28 35·91	+55 44 11·6
	8 51 55	+5 13·63	+0 3·7	2 *a*	15 30 29·00	+55 41 5·6
	9 33 34	+5 56·91	−1 19·9	2 *a*	15 31 12·28	+55 39 42·0
11	6 59 21	−1 21·99	−6 14·6	2 *b*	15 53 2·39	+55 2 46·4
	7 12 15	−1 18·14	−6 40·4	2 *b*	15 53 16·22	+55 2 20·6

Mean Positions of Comparison Stars for 1857.

	R.A.	Decl.	
	h m s	° ′ ″	
a	15 25 15·27	+55 41 16·7	Oeltzen 15423
b	15 54 24·95	+55 9 13·0	B.A.C. 5313

"The first observation being made with a small refractor, is less worthy of confidence than the others made with the great refractor of Amici (aperture $0^m \cdot 28$, focal distance $5^m \cdot 2$.)

"The comet is very faint, and has no indication of nucleus or tail."

Observations of Hestia at 2 South Parade, Oxford.
By Norman Pogson, Esq.

1857.	Oxford M.T.	App. R.A.	Log. Par. × Δ	App. Dec.	Log. Par. × Δ
	h m s	° ′ ″		° ′ ″	
Aug. 16	9 49 10	305 6 47·4	−0·079	−16 20 53·7	+0·898
	10 47 24	305 6 24·2	+9·287	−16 21 2·0	+0·900
	12 29 51	305 5 40·4	+0·412	−16 21 18·4	+0·890
17	12 17 56	304 54 53·1	+0·386	−16 25 22·0	+0·892

Magnitude 11·3

The comparison stars reduced to 1857·0 were

		Mean R.A.	Mean δ
		° ′ ″	° ′ ″
A Z 249·62	7	305 40 39·0	−16 14 47·6
A Z 249·55	9·10	304 6 50·0	−16 28 2·4

The observations were made with a ring-micrometer, and corrected for refraction and the planet's motion.

The forty-sixth minor planet, since named *Hestia* on the suggestion of Admiral Smyth, was discovered by Mr. Pogson at his private residence, No. 2 South Parade, Oxford, and not at the Radcliffe Observatory, as stated by an oversight in the last *Monthly Notice*. The discovery was made with the 5-feet Smythian telescope of the Hartwell House Observatory, kindly lent by Dr. Lee to Mr. Pogson for private use. Mr. Pogson was similarly indebted to Mr. Frodsham for the chronometer which he employed in his observations.—[Editor.]

Elements of Comet VI. 1857. By M. Pape.*

T	= Nov. 19·07874, M.T. Berlin.	
ϖ	= 44 ° 15 ′ 25 ″	Mean Equinox, 1857·0
Ω	= 139 18 40	
i	= 37 50 1	
Log q	= 0·003976	

Motion retrograde.

These elements have been calculated from the Florence obser-

* *Ast. Nach.*, No. 1118.

vation of Nov. 11, and the following two observations of Nov. 15 and 18 made by Professor Peters at Altona :—

	M.T. Altona.	α	δ
	h m s	° ′ ″	° ′ ″
1857, Nov. 15	7 33 26·8	260 30 22·1	+49 22 40·1
18	6 4 14·9	272 47 51·7	43 18 49·1

M. Pape has calculated an ephemeris of the comet, extending from Nov. 20 till Dec. 10, which will be found in the periodical from which these elements are extracted.

At the close of the meeting, Mr. Warren De La Rue exhibited a great variety of beautiful photographs of the moon, several of which he liberally placed at the disposal of Fellows of the Society. He also made some remarks on the application of photography to recording the appearances of the heavens, and more particularly of those presented by the moon and the larger planets.

Mr. Bond, of Cambridge, in the United States, was the first, he believed, who obtained a photographic impression by means of the telescope of the lunar surface. At a subsequent period, in the year 1852, Mr. De La Rue applied the collodion, assisted by Mr. Thornthwaite, and obtained an excellent image of the moon; and he had the honour of exhibiting it to the Society, and of describing the apparatus by which he obtained it.

It is difficult to follow the moon's motion in any telescope without the aid of a clockwork driver ; nevertheless, by means of a sliding plate-holder in the place of the ordinary eye-piece, he was able to do so by viewing the image through the collodion film. The particular form of apparatus employed he had the pleasure of describing at that period to the Society.

Mr. De La Rue soon relinquished the pursuit of lunar photography, because it required two enthusiasts ; one to uncover the mouth of the telescope, and one to follow the moon's apparent motion; and it was not easy to find a friend always disposed to wait up for hours, night after night, probably without obtaining any result. He, therefore, resolved to discontinue his photographic experiments till he had applied a clock-motion to his telescope. This he has done during the present year, and he has taken the earliest opportunity of resuming his experiments.

The first results Mr. De La Rue obtained were similar to those described in 1852, and were produced by employing collodion and obtaining positive images of the moon. He was very successful from the onset, and had been enabled to distribute a few enlarged copies of a photograph obtained on September 7th. There were also copies of it on the table for the use of the members then present.

More recently Mr. De La Rue has been induced to make experiments in the production of negative collodion pictures, for two

reasons: first, because they admitted of more easy multiplication, and secondly, because the image is much finer in grain. In the positive pictures the precipitation of the silver is in larger particles than in the negatives.

The paper copies before the Society were derived from a positive picture, which in the telescope was obtained in five seconds. When this was procured he was unable to obtain a good negative in less than fourteen seconds. However, his friend, Mr. Howlett, lately put him in the way of making negative collodion very sensitive, and he obtained negative impressions in ten seconds. Since this, by paying particular attention to the state of the bath, he had been very successful in still reducing the time of exposure, and had produced pictures, not only of the lunar surface, but also of *Jupiter*, in from three to seven seconds. The photographs of *Jupiter* show his belts remarkably well.

The beauty of the photographs exhibited of the moon, he thought it would be admitted, gave great promise that at a future period photography will be considered as the only correct means of mapping down the lunar surface. When we shall be able to obtain collodion finer in grain and still more sensitive, it will supersede hand-drawing altogether; and even now the results obtained are much more accurate than anything hitherto done by mapping or hand-drawing. It is nearly impossible by micrometrical measurement to lay down all the details of the moon, and much, after a sort of triangulation, has to be filled up by eye. The work is too laborious; and the famous map of Beer and Mudler, wonderfully accurate as it is, does not fulfil the conditions of absolute accuracy in all the minute points of detail.

Mr. De La Rue mentioned that the clock-motion of his telescope is regulated by the ordinary governor balls. It will keep the moon or a star in the field, or "on the wire," as it is called, for an hour or two; its mean motion being very correct and easily regulated; but there are occasionally some little differences of friction which make the star sometimes go a little on one or other side of the wire, but sometimes it will remain for fifty or sixty seconds absolutely without any apparent motion.

In the case of lunar photography it is desirable to obtain as rapid a process as possible; not only on account of the irregularity of the clock-motion, but on account of the moon's motion in declination. Moreover, during the whole time necessary for exposure the atmospheric changes are moving the image sensibly, and frequently to a much greater extent than is due to the irregularity of the clock's motion. Even if the change in declination were compensated by a motion at right angles,—and such a compensation as is required is easy to conceive,—yet the outstanding atmospheric disturbance of the image would still remain.

The Astronomer Royal had a few words to say about photography, and would exhibit an image produced in a transit instrument, which makes evident the disturbance arising from atmospheric causes. The conditions for obtaining the extreme

sensitiveness of the collodion film required, are exactly those conditions which produce a film in which the silver has a tendency to be reduced by the reagents, even without exposure to light. It is indeed in such a state of sensitiveness that a little particle of foreign matter may cause a reduction of silver on those portions of the plate unacted upon by light, when the developing reagent is poured on the plate, and hence we have the phenomenon which is known to photographers as *clouding*. This is only to be got over by attention to the bath, putting a little acetic acid or carbonate of soda, as may be required, so that it may be only slightly acidified with acetic acid.

Mr. De La Rue stated that he had obtained between twenty and thirty good photographs of the moon during the last two months, and about six of *Jupiter*, enlarged copies of which he now exhibited; and by means of a magnifying glass of moderate power, it would be seen that those copies display a considerable amount of detail, not visible to the unassisted eye. Yet the originals had been copied in the copying camera in foggy weather, and had not all the sharpness of the original negatives.

While on the subject of lunar photography, Mr. De La Rue begged to direct the attention of the Society to one or two points of physical interest, which may be thus stated: points on the lunar surface having optically equal intensity of light, do not produce equally brilliant positive and equally obscure negative impressions; the actinic rays are evidently not always in proportion to the illuminating rays. Another curious fact, which he thought he had well made out, is, that those portions of the lunar surface which are illuminated by a very oblique ray from the sun, do not produce an equal effect on the sensitive plate, though they are equally bright to the eye. Such a phenomenon obtains during the afternoon in terrestrial photography, when the sun's rays reach us obliquely through the atmosphere. The moon has no visible atmosphere; nevertheless, from whatever cause it may arise, that portion of the moon which is illuminated by an oblique ray, does not produce a corresponding effect on the sensitive plate, which it does to the eye.

The photographs exhibited had been copied by his friend Mr. Howlett, by means of a camera which he had had expressly made.

Exhibition of Bond's Photograph of ζ and g Ursæ Majoris, and of the Transit of α Lyræ.

The Astronomer Royal exhibited a collodion photograph of the double star ζ *Ursæ Majoris*, with its companion *g Ursæ Majoris*, formed by the magnificent refractor at Harvard College, Cambridge, U.S., which had been placed in his hands by Mr. Bond, with a special request that he would exhibit it to the members of the Society.

Upon the same plate of glass there are, in fact, two complete

photographs of the entire system. They are, however, such exact counterparts one of the other, that they require no distinction of notice.

The principal information which we possess in regard to the process employed is that given in the *Astronomische Nachrichten*, No. 1105. The time there mentioned as necessary for forming the image of the smaller stars is eighty seconds; although that of a bright star is formed in two or three seconds, or sometimes almost instantaneously. The longer time must necessarily have been employed in forming the images now exhibited.

The representation of the stars is very beautiful. The image of the large star is rather broader than would be desirable for the measure of distance and position of a faint companion, but it is perfectly circular. It bears good testimony to the excellence of the telescope and the accuracy of the movement of its clockwork.

On measuring the linear distance between the images of ζ and g, and comparing it with the angular distance derived from late catalogues, it appears that the practical focal length of the telescope is about 21 feet 10 inches. This is the distance of the image from the interior focal centre of the object-glass. We have no means of knowing the exact position of that focal centre, but it is possible that it may be at a small distance from the inner surface of the object-glass, between that surface and the eye-end. The focal length of the telescope, as stated by Mr. Bond, is 22 feet 6 inches; this is probably measured from the exterior surface of the object-glass. The difference probably arises, partly from the distance of the inner focal centre from the exterior surface of the object-glass, partly from the shortening of the focal length for photogenic rays, which has been found to exist in the best achromatized object-glasses.

The Astronomer Royal expressed his feeling that a step of very great importance had been made, of which, either as regards the self-delineation of clusters of stars, nebulæ, and planets, or as regards the self-registration of observations, it is impossible at present to estimate the value. The most cordial thanks of astronomers are due to Mr. Bond and to the professional amateurs, Messrs. Whipple and Black, by whose perseverance this object had been obtained.

The Astronomer Royal also remarked that two matters to which he had often called attention, the firmness of equatoreal mounting and the uniformity of clock-work movement, now claimed our regard more urgently than ever. He hoped that he might engage upon these two subjects the efforts of the excellent mechanics whom we see in regular attendance at the meetings of the Society.

1857, *Oct.* 5.

It appears from a letter subsequently received from Mr. Bond that the chemical focus of the telescope is about $1\frac{1}{4}$ inch longer than the optical focal length. The error in the calculated focal

length undoubtedly arises from some small error in measuring the interval of images on the plate.

The Astronomer Royal also stated that he had received from Mr. Bond a photograph of a transit of *α Lyræ*, which unfortunately had been so much broken in its conveyance by post (though carefully packed) that it was not fit for general exhibition. Enough of it, however, remained to show clearly that the transit-line is abundantly strong and well marked, and that it is uneven.

The Astronomer Royal exhibited photographs which he had received from Mr. Lassell, of the mounting of the large reflector which he is now preparing to erect. The diameter of the mirror (not yet worked) is to be 4 feet, the same size as Sir William Herschel's largest mirrors. The tube is a skeleton. The mounting is equatoreal, similar in its general form to that which Mr. Lassell has used with smaller telescopes. A part of the apparatus of which the plan is perfectly novel is the observing-box. It is something like a very tall sentry-box, between 30 and 40 feet high, in which slides upwards and downwards a cage like the teagle of a cotton-mill; in this cage the observer is stationed. The tall box stands upon a ring-turn-table which surrounds the telescope's polar axis. The ring appears to have a motion in azimuth, and the tall box has a radial motion on the ring; and the combination of these two motions with vertical motion of the teagle gives command of the telescope's mouth in all positions. The tall box is so arranged that, when the telescope is turned to a proper azimuth, and is depressed to a nearly horizontal position, the tall box, turning upon a hinge at its base, can be lowered over the telescope-tube to protect it from the weather.

Mr. Warren De La Rue said, he had had the pleasure of seeing the models of Mr. Lassell's telescope, from which the photographs were taken. In addition to the particular motions described, the mounting for the observer was hinged, so as to cover the telescope; and it also turned upon an axis, so as to present the observer in the most favourable position with regard to the eye-piece. He had himself, with the labour of five years, mastered the process of making a 13-inch reflector; but the labour incurred by Mr. Lassell was enormous. He had to mount a telescope, the reflector of which weighed a ton and a half. This required a special set of experiments, and the erection of machinery for polishing, &c., besides the labour and expense of transporting it to Malta. Under these circumstances they had reason to be proud of the energy Mr. Lassell had displayed.

The following extract from a paper by Mr. Bond, recently published in an American journal,* contains some further informa-

* "Boston Daily Advertiser," June 8, 1857.

tion respecting Mr. Bond's labours in applying photography to astronomical purposes:—

"The near approach of the star *Spica Virginis* to the moon on the evening of the 2d instant presented a favourable opportunity for testing the practicability of obtaining photographic impressions of a star when in close proximity to the moon; it being a question which had hitherto never been decided, Whether the diffused light in the immediate vicinity of the moon would not overpower the actinic effect of the star? Preparations were accordingly made at the Observatory of Harvard College for the purpose of deciding this point; and as Messrs. Whipple and Black, the eminent daguerreotypists, to whom we have on former occasions been so much indebted, volunteered their services, a large number of photographic pictures of the moon and the star in its neighbourhood were obtained before and after the eclipse; even at the emersion, when the star was in apparent contact with the bright limb of the moon, its image was distinctly formed.

"The experiment was perfectly successful, pictures of the lunar mountains were impressed on the glass plates by the collodion process simultaneously with that of the star, with minuteness and precision, serving as admirable points from which to measure the distance and position of the star.

"It is a curious fact worth noticing that in every instance the impressions of the star were, if anything, *too strong*,—the very reverse of what had been anticipated; the possible minimum time of exposure of the plate requisite for obtaining a visible impression of the object upon it could not at that time be ascertained. This is a favourable indication, as the shorter the time required the more accurate will be the result.

"W. C. Bond.

"*Harvard College Observatory, Cambridge,*
"*June 5th*, 1857."

Astronomical Observations made at the Royal Observatory, Edinburgh. By Charles Piazzi Smyth, F.R.SS.L. & E., F.R.A.S., &c., Vol. XI., Edinburgh, 1857.

This volume contains the meridional observations made at the Edinburgh Observatory from 1849 to 1854 inclusive, with the necessary corrections for instrumental and clock-error, and the final reduction to mean right ascension and north polar distance. The objects observed are exclusively stars. The labours for each year are kept separate. Appended to the volume is an account of occasional observations. These are, first, Observations of Earth-Thermometers from 1837 to 1854; second, An experimental trial of the Theory of Solar Refraction; third, Contributions to Lunar Physics; and fourth, an account of the Total Solar Eclipse of 1851. The first, third, and fourth papers are accompanied by coloured lithographic illustrations. The first, second, and fourth papers

have been already noticed in the publications of the Society. The third paper consists of an interim report on the Mare Crisium, undertaken at the request of, and presented to, the Lunar Committee of the British Association for the Advancement of Science, September, 1854. The report is accompanied by three striking views of the Mare Crisium. At the Hull meeting of the Association in 1853, a committee, consisting of the Earl of Rosse, Dr. Robinson, and Professor Phillips, had recommended the execution of a new series of drawings of certain parts of the moon's surface. In order to acquire correct ideas respecting the moon's physical structure, it was considered indispensable that it should be observed under at least three aspects, viz. a little after the sun rose on the part to be delineated, when the sun was on the meridian of the same part, and a little before the sun set upon it. The long shadows in the first and third instances would serve to discover the inequalities of level, while the vertical incidence of the light in the second instance would indicate the unequal reflective powers and different colours which characterise the different lunar regions and the systems of brilliant stripes which are connected with certain lunar forms. Professor Smyth was one of those invited to co-operate in the preparation of these drawings; and in accordance with the suggestions of the Committee, he has executed three distinct delineations of the Mare Crisium, which are to be found among the lithographic engravings above referred to. We extract the following passages from the brief Report of Professor Smyth on the subject:—

"But so extensive a surface as that proposed to me by the Committee, viz., the Mare Crisium and its shores, can hardly be done justice to by only three drawings, viz., in each of the prescribed illuminations, for when one boundary is exhibiting the lights and shadows of elevation and depression in the most instructive manner, the opposite boundary is then beginning to show those physical and often very diverse phenomena which are brought out by a vertical illumination.

"After, and not till then, that the greater number of the sketches had been obtained, Beer and Mädler's map was referred to. The result went to show their exceeding accuracy and admirable completeness in certain topographic particulars, expressed in a peculiar conventional style; but it failed in giving the physical and mechanical features as they are seen in the telescope, and as they exist in nature; yet these physical and mechanical forms are absolutely essential for the purpose of enabling any quasi-geological speculation to be safely entered upon.

"Indeed it is radically impossible for any one map to give all the features; for the shading which is introduced to express the depth of a crater, and its apparent blackness at the new or old moon, is at once and directly opposed to the indication of the excessive whiteness of its internal walls as revealed at the full moon.

"In the drawings now presented exactly such a case is offered by the crater Proclus; whose walls, by the way, are *not* broken through towards the north, as shown in the German map.

"Equally difficult is it on any one map, and that on a small scale, to exhibit how completely the monster craters of Macrobius and Cleomedes, with the high conical mountains, north and south of Proclus, and the cliffy and vertically stratified ranges on the north-west border of the Mare, disappear under a vertical illumination; while there come forth the bright radial markings of Proclus, and in its neighbourhood a large and very luminous inroad into the Mare, completely altering its contour at that part. The crater of Proclus, with its internal walls so brilliant and so sharply defined, then becomes the prominent object of all that region, though with the side light it is least so."

A Catalogue of 3735 *Circumpolar Stars, observed at Redhill in the years* 1854, 1855, *and* 1856, *and reduced to Mean Positions for* 1855·0. By Richard Christopher Carrington, Fellow and Secretary of the Royal Astronomical Society of London. Printed at the Public Expense, by order of the Lords Commissioners of the Admiralty. 151 pp., folio. London, 1857.

In an Introduction, extending to 62 pages, Mr. Carrington describes the instruments and method of observation employed in the construction of this Catalogue. A few details relating to the same object have occasionally appeared in the pages of the *Monthly Notices*. The Observatory was erected with a special view to the prosecution of labours of the class to which those recorded in this work belong. In July 1853 the building was sufficiently advanced to enable Mr. Carrington to place in position his meridian instrument, a transit-circle of 5·0 inches aperture by Mr. Simms. In the previous February he had fitted up, under the dome of the observatory, an equatoreal by the same maker of 4·5 inches aperture.

The following plan of operations is stated by Mr. Carrington to have been undeviatingly adhered to throughout:

"1. Rough observations with the equatoreal in broad zones of about 1000 stars, as a basis for an improved map of the region comprised within 9° of the north pole, the reduction to 1855 depending on about 90 previously known stars.

"2. Laying down these rough positions to scale, and filling in the stars previously omitted by estimation, intentionally including stars somewhat exceeding the limit of magnitude of the final Catalogue.

"3. The construction from the maps thus formed, of a provisional Catalogue arranged in order of right ascension, and containing about 4400 stars.

"4. Observations on the meridian in three sub-zones, each forming a full year's work, of such of the stars in the provisional Catalogue as were not too faint to be seen under feeble illumination. For stars within 45′ of the pole, the rule was five or six observa-

tions; for stars from 0° 45′ to 4° polar distance, four or five observations; and between the parallels 4° to 7° and 7° to 9° polar distance, three observations.

"5. The reduction to 1855·0 and assembling of the individual results of the three sub-zones into a final catalogue of mean positions, and the permanent engraving on copper of a corresponding chart in nine sections of convenient size."

The construction of maps from the observations with the equatoreal, and the formation from them of an arranged provisional catalogue, occupied Mr. Carrington during the greater part of the year 1853.*

In the section devoted to a detailed description of the transit-circle, Mr. Carrington gives an account of two small telescopes placed north and south of the instrument for the purpose of determining the error of collimation. These collimators were also used for ascertaining the flexure of the principal parts of the instrument under certain conditions of strain to which they were mechanically subjected. The clock employed in the observations was provided with a dead-beat escapement, and was constructed by the late Mr. Henry Appleton, of Southampton Row, Russell Square.†

On the mode of observation pursued by Mr. Carrington we extract the following statement:—

"In observing stars for the Circumpolar Catalogue it was, as before stated, an adopted principle with me that in all cases the positions should be at least three times observed; that in every instance there might be the means of deciding without conjecture the nature of errors of entry. To bring the work of observation of nearly 4000 stars, involving nearly 15,000 single observations, within reasonable limits of time, the opportunities of the climate being known, it was sufficiently obvious that the observer would have to content himself on each occasion with recording the time of passage over a single wire, and a circle-reading depending on single bisections. I was aware that the condition was not one which would enable me to exhibit results of the first accuracy to a critic who should run his eye down the columns of residual errors without being aware of the circumstance; but it appeared to me to be so much more important that every final position of the concluded Catalogue should thus be the indisputable result of at least three independent processes, than that a less number of individual results should singly exhibit a greater degree of accordance, with the certainty that among the derived results there would be a percentage essentially faulty or doubtful, that my choice was soon made."

The clock-error was determined by observations of 56 south stars, the adopted right ascensions of which were derived from the Greenwich Observations for 1851–2–3. It was invariably

* For a description of these provisional maps and the mode of their construction, see *Monthly Notices*, vol. xiv. p. 40.

† The reader will find some details respecting Mr. Carrington's observatory and instruments in vol. xiv. of the *Monthly Notices*, pp. 13–15.

Mr. Carrington's practice to observe those stars over the seven wires of the telescope. The Greenwich position of the equinox is assumed as the basis of the right ascensions of the Catalogue; but Mr. Carrington justly remarks that a small error in this fundamental element cannot produce a sensible effect on the positions of stars near the Pole.

The collimation error was regularly determined by means of the two collimators. The meridian error resulting from the combined effects of the errors of level and azimuth was ascertained by observations of twenty polar stars, the positions of which Mr. Carrington had carefully determined with a view to that object.*

In computing the corrections for precession, nutation, and aberration, Mr. Carrington encountered a peculiar difficulty from the close proximity of many of the stars to the Pole.

For convenience, he had subdivided the region of his operations into three sections, or sub-zones. The first sub-zone contained all the stars within 4° of the Pole; the second, those lying between 4° and 7° of polar distance; and the third, the remainder. To the stars of the second and third sub-zone it was not considered necessary to apply more than the ordinary terms of the first order of the general formula, expressing the above corrections; but to stars within 4° of the Pole, and to the special polars throughout the work, the terms depending on 2 ☾ were applied. Besides, there were 19 stars, situate within 42′ of the Pole, the corrections for which were computed by a peculiar process. The constants adopted were those given by Dr. Peters in his *Numerus Constans Nutationis.*

The Introduction concludes with a tabular statement of the instrumental errors, and is accompanied by an Appendix, containing a demonstration of the formulæ for precession, nutation, and aberration; and a few subsidiary tables.

The Catalogue is comprised in sixty-three pages, and is arranged in eight columns. The first column contains the number of the star; the second, the magnitude; the third, the number of individual observations; the fourth, the right ascension for 1855·0; the fifth, the difference in right ascension between the position of the Redhill Catalogue and the position deduced by M. Oeltzen of Vienna, from the observations of Professor Schwerd, brought up by Mr. Carrington from 1828·0 to 1855·0; the sixth, the north polar distance for 1855·0; the seventh, the difference in north polar distance between the Redhill Catalogue and Schwerd. The eighth column is set apart for occasional notes.†

The Catalogue is followed by the individual observations arranged in three sub-zones in the order in which they were

* The reader will find the position of these polar stars, as ascertained by Mr. Carrington, at page 2 of vol. xv. of the *Monthly Notices.*

† Since the number of circumpolar stars observed by Schwerd is less than a fifth of the number contained in Mr. Carrington's Catalogue, it follows as a matter of course that the fifth and seventh columns must be only partially occupied.

taken. The accordance which everywhere is presented on examining this part of the work will enable the reader to form some estimate of the high value of Mr. Carrington's labours and of the important service which he has thereby rendered to astronomy. Mr. Carrington has inserted at the end of his Catalogue an Appendix containing the positions of 680 stars observed by Professor Schwerd at Speyer (the stars above alluded to); and 50 stars observed by E. J. Cooper, Esq., at Markree, brought up to 1855·0, and compared with the positions observed at Redhill. Professor Schwerd's stars have recently been reduced to 1828·0 by M. Oeltzen of Vienna. The stars observed by Mr. Cooper had been reduced to 1842·0, and were published in No. 490 of the *Astronomische Nachrichten.*

Mr. Carrington cordially acknowledges the valuable services of his friend and assistant Mr. George Harvey Simmonds, who shared nearly all his labour in observing, and bore about three-fifths of the more serious labour of computation.

Accompanying his Catalogue are nine circumpolar charts, which Mr. Carrington constructed from the final positions of the stars therein given, and engraved himself upon copper. We here discern the same masterly finish and lucid arrangement which characterize the more important part of his labours.

The *Nautical Almanac* for 1861 has recently been published. Besides the usual matter, it contains the Astronomer Royal's Day Numbers for correcting the places of the stars, (*Mem. Ast. Soc.* Vol. XVI. p. 329; *Monthly Notices*, Vol. VII. p. 189). In the part devoted to calculated astronomical occurrences for the year 1861 will be found the numerical details relating to the annular eclipse of the sun of July 7 (invisible at Greenwich), the total eclipse of the sun of Dec. 30–31 (visible as a partial eclipse at Greenwich), and the transit of *Mercury* over the sun's disk, Nov. 11, partly visible at Greenwich. A supplement to the Almanac contains elements and ephemerides of most of the minor planets for the year 1858, and an ephemeris of *Neptune* for the same year.

Occultation of Mars by the Moon, on the 13*th of October.*

Observed by C. Leeson Prince, Esq.

"I had a favourable opportunity of witnessing the occultation of *Mars* by the moon this morning. The following observations may, perhaps, be interesting: —

	Mean Time.		Mean Time.
	h m s		h m s
First contact ...	16 47 1	Reappearance ...	17 44 10
Disappearance ...	16 47 16	Last contact ...	17 44 23

"At the moment of reappearance, and of last contact, the planet's disk was well defined.

"Telescope 6·8 inches aperture, and 12 feet focal length. Magnifying power employed, 144.

"*Uckfield, Sussex,*
"Lat. 50° 28′ 25″ N."

Observed by T. W. Burr, Esq.

	Local Sidereal Time. h m s	
Emersion	7 13 25·6	Dark Limb of Moon.

The Immersion was not seen. The dark limb of the moon was distinctly visible, notwithstanding strong morning twilight, and the time recorded is that of the first instant of the planet's reappearance.

Owing to the use of a low power and the small apparent diameter of *Mars* at present, separate observations of the emergence of both edges of the planet could not be made, as he reappeared like a star, but having a perceptible increase of brilliancy until completely divided from the moon's disk. Telescope, 4 ft. 4 in., focal length, $3\frac{3}{8}$ in. aperture. Power, 58.

Highbury, Nov. 1857.

Observed by Capt. W. Noble.

"The disturbed state of the atmosphere did not admit of employing a higher power than 154. The planet entered into contact at $6^h\ 17^m\ 41^s{\cdot}4$ Local Sidereal time. For a very few seconds afterwards, the appearance was presented of a dark shade on the planet's disk, where the moon's limb crossed it, analogous in effect to that depicted by Mr. Lassell at page 70 of Vol. XVII. of the *Monthly Notices*. The planet finally disappeared at $16^h\ 17^m\ 56^s{\cdot}9$ Local Sidereal Time. The reappearance was imperfectly observed in consequence of the unfavourable state of the weather. The telescope employed was an equatoreal by Ross, of 4·2 inches aperture, and of 61 inches focal length. Approximate latitude and longitude 51° 0′ 58″ north, and $17^s{\cdot}5$ east.

"*Maresfield, Sussex, 15th October,* 1857."

ERRATA.

Vol. XVII., page 264, line 15, *for* 'the Radcliffe Observatory,' *read* '2 South Parade, Oxford.'

— — 273, Index, under 'Clark, Alvan,' *for* 'Measures of double stars,' *read* 'New double stars discovered by.' Under 'Dawes,' *for* 'Remarks on Mr. Alvan Clark's measures of double stars,' *read* 'Remarks on Mr. Alvan Clark's new double stars.'

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